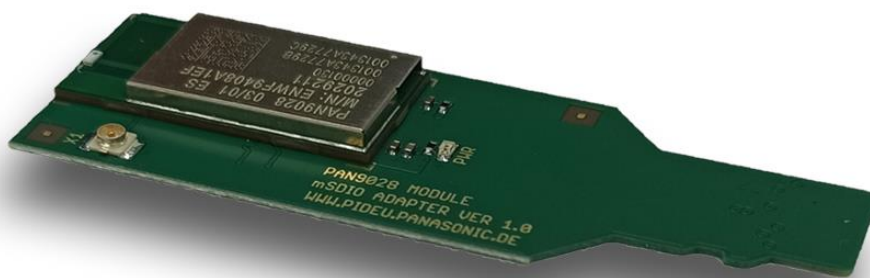


PAN9028

Wi-Fi Dual Band 2.4 GHz/5 GHz and Bluetooth® Module

Quick Start Guide

Rev. 1.0



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Table of Contents

1	About This Document	4
1.1	Purpose and Audience	4
1.2	Revision History.....	4
1.3	Use of Symbols	4
1.4	Related Documents	5
2	Overview	6
2.1	Wi-Fi Features	6
2.2	Bluetooth Features	6
3	Installation	8
3.1	Setup Boot Card	8
3.2	Using Device for Remote Control	9
4	Basic Usage	10
4.1	Setup (Basic).....	10
4.2	Connecting to the Access Point.....	11
4.3	Remote Controlling PAN9028-IMX	12
4.4	Exploring Wi-Fi Features	12
4.5	Exploring Bluetooth Features	16
5	Full Usage	21
5.1	Setup (Full).....	21
5.2	Login.....	22
5.3	Configuring Audio	23
5.4	Configuring Wi-Fi.....	24
5.5	Accessing Network	24
5.6	Using Wi-Fi Location Demo	25
5.7	Remote Access	28
6	Recreating SD Card Image	29
6.1	Using Windows®	29
6.2	Using Linux.....	29
7	Troubleshooting	31
7.1	Resizing Root Partition to Maximum Size.....	31
7.2	Fixing a Non-Booting System	31
7.3	Updating System	32
8	Life Support Policy	33
9	Contact Details	34
9.1	Contact Us.....	34
9.2	Product Information	34

1 About This Document

1.1 Purpose and Audience

This Quick Start Guide explains how to setup the PAN9028-IMX which consists of a Wandboard Dual (WB-IMX6U-BW) and PAN9028-MSD.




It describes the basic usage modes and gives an introduction to the software that is provided.

The document is intended for software engineers.

1.2 Revision History

Revision	Date	Modifications/Remarks
1.0	2021-07-08	Initial version

1.3 Use of Symbols

Symbol	Description
	Note Indicates important information for the proper use of the product. Non-observance can lead to errors.
	Attention Indicates important notes that, if not observed, can put the product's functionality at risk.
	Tip Indicates useful information designed to facilitate working with the software.
⇒ [chapter number] [chapter title]	Cross reference Indicates cross references within the document. Example: Description of the symbols used in this document ⇒ 1.3 Use of Symbols .
✓	Requirement Indicates a requirement that must be met before the corresponding tasks can be completed.
→	Result Indicates the result of a task or the result of a series of tasks.
This font	GUI text Indicates fixed terms and text of the graphical user interface. Example: Click Save .

Symbol	Description
Menu > Menu item	<p>Path</p> <p>Indicates a path, e.g. to access a dialog.</p> <p>Example:</p> <p>In the menu, select File > Setup page.</p>
<code>This font</code>	<p>File names, userinput</p> <p>Indicates file names or messages and information displayed on the screen or to be selected or entered by the user.</p> <p>Examples:</p> <p><code>pan1760.c</code> contains the actual module initialization.</p> <p>Enter the value <code>Product 123</code>.</p>
<code>This font</code>	<p>Systemoutput</p> <p>Indicates messages and information displayed on the screen.</p> <p>Example:</p> <p>The message <code>Failed to save your data</code> is displayed.</p>
Key	<p>Key</p> <p>Indicates a key on the keyboard.</p> <p>Example:</p> <p>Press F10.</p>

1.4 Related Documents

For related documents please refer to the Panasonic website ⇒ [9.2 Product Information](#).

2 Overview

The PAN9028-IMX is a development platform for the Wi-Fi/Bluetooth® PAN9028.

The PAN9028 requires a fairly powerful host processor that executes the low-level Wi-Fi driver as well as some high-level Wi-Fi application software. Because of this, the Wandboard was chosen as the hardware platform. It is based on the well-known and powerful NXP® i.MX6 processor and provides a separate µSD card slot for attaching peripheral devices like the PAN9028-MSD.

A Linux®-based installation was chosen as the software platform. The Linux kernel provides an established environment for running a Wi-Fi driver and the available Wi-Fi applications make it possible to use the PAN9028 to its full extend.

Two different software environments are available for the PAN9028-IMX: Ubuntu Linux and Yocto Project Linux.

The Ubuntu Linux based environment is available to showcase all the different possibilities of the PAN9028 which also allows the user to experiment with the system, using a graphical user interface (GUI). This environment is described in this Quick Start Guide.

The Yocto Project Linux based environment is available to showcase the easy integration into a customer-specific build environment. This environment is described in the “Development Guide” which is available separately.

Both environments provide access to the Wi-Fi and Bluetooth features of the PAN9028 by supplying a web server running on a Wi-Fi access point. After a connection to that access point has been established, it is possible to interact with the PAN9028 with the browser.

The Ubuntu Linux based environment additionally provides a GUI that many are familiar with and that allows the user to explore the PAN9028 using a full-featured Linux desktop environment.

For related documents please refer to ⇒ [9.2 Product Information](#).

2.1 Wi-Fi Features

The PAN9028 provides a web server interface through a Wi-Fi access point that devices can connect to. It can simultaneously connect to another Wi-Fi access point and relay any internet connectivity from there.

All Wi-Fi features can be controlled from the GUI as well.

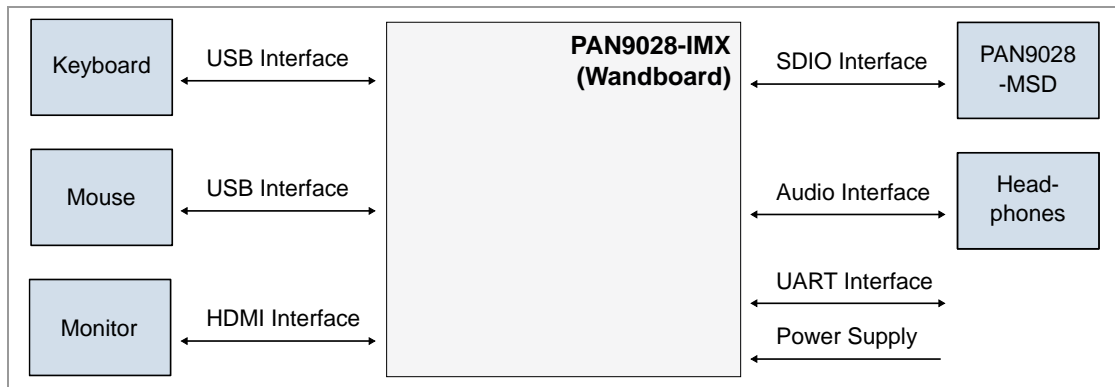
2.2 Bluetooth Features

It is possible to select different Bluetooth applications through the user interface, provided by the web server. The Bluetooth Basic Rate A2DP profile allows the PAN9028-IMX to become a Bluetooth audio sink. It is possible to playback audio from a remote device that is connected via Bluetooth Basic Rate.

Alternatively, the PAN9028-IMX may become a Bluetooth Low Energy proximity beacon, using the AltBeacon Protocol, which may be used for indoor navigation.

All Bluetooth use cases have been implemented, using Blue SDK from OpenSynergy.

3 Installation



The PAN9028-IMX consists of the following components:

- PAN9028-MSD (μ SD card form factor)
- Wandboard Dual (WB-IMX6U-BW)
- USB power cable as power supply
- μ SD card with Ubuntu Linux image (already inserted)

The following additional components are not included, but may be required depending on the use case:

- USB hub (the Wandboard only has a single USB connector)
- RS232 serial connection cable (interface the built-in UART port to a control PC)
- HDMI cable and HDMI monitor or TV set (show the GUI of the Ubuntu Linux)
- USB mouse and USB keyboard (interface with Ubuntu Linux)
- USB memory stick (transfer data to and from the PAN9028-MSD)
- Headphones with 3.5 mm jack (listen to Bluetooth audio)
- Some Wi-Fi capable device like a mobile phone or a tablet

3.1 Setup Boot Card

The Wandboard consists of two separate parts:

- the Baseboard that contains all the connectors and
- the system-on-module that contains the i.MX6 processor.

The system-on-module is located on the back of the Wandboard and may have a heat-spreader covering the processor.

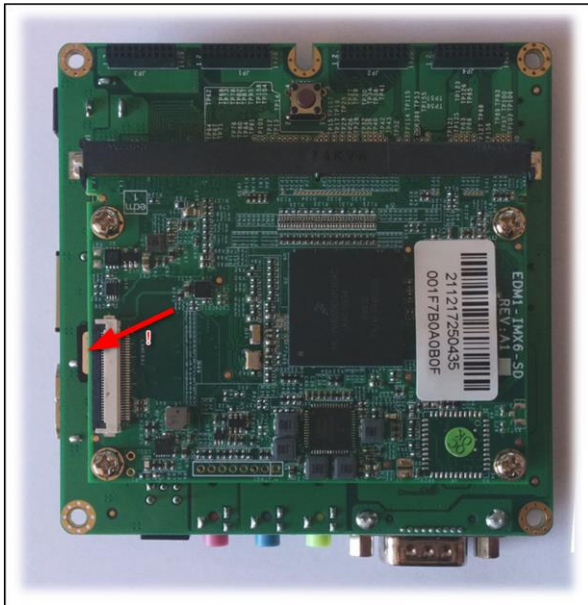
The Wandboard has two μ SD card slots:

- one for the boot medium which is located on the system-on-module and
- one for peripheral devices which is located on the Baseboard.

Inserting μ SD

Ideally the μ SD card with the Ubuntu Linux image is already inserted in the μ SD card slot on the system-on-module, so that the Wandboard will boot from it, if not:

1. Turn around the Wandboard. The audio connectors are facing downwards.
2. The μ SD card slot of the system-on-module can be found on the left side.



3. Gently press the connector.
→ The μ SD card will spring out.



Remember the orientation of the contacts. The contacts must face upwards when the μ SD card is inserted.

3.2 Using Device for Remote Control

Certain functions of the PAN9028-IMX can be remote controlled via Wi-Fi. A Wi-Fi capable device for controlling is needed.

Disabling a Mobile Data Plan

If a mobile device is used that has a SIM card, which supports a mobile data plan for accessing the internet, it is recommended to switch off the mobile data plan while working with the PAN9028-IMX. The Wi-Fi access point, provided by the PAN9028 initially, does not provide access to the internet.

If a mobile plan is available, Android may route any network traffic through the mobile data plan to the internet, instead of using the seemingly non-functional access point.

To avoid confusion and force Android to route the network traffic through the access point of the PAN9028, it is recommended that the mobile data plan is switched off.

4 Basic Usage

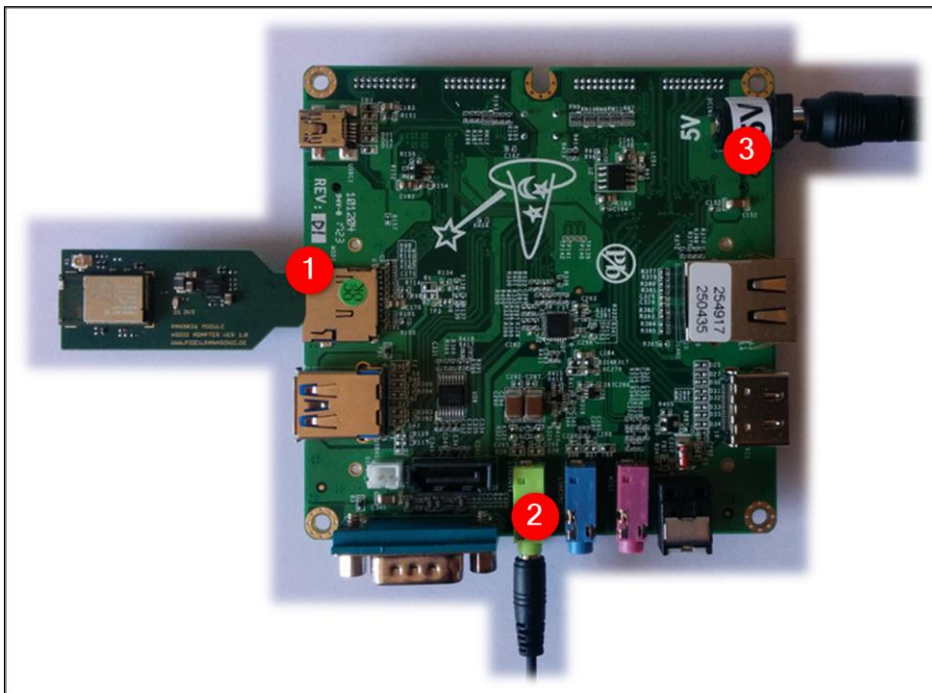
The basic usage includes all features that can be accessed with the remote device connecting to the Wi-Fi access point only. It does not need any additional peripherals.

4.1 Setup (Basic)

The following components are needed:

- ✓ Wandboard with μ SD card with Ubuntu Linux image
- ✓ PAN9028-MSD with μ SD card form factor
- ✓ Headphones with 3.5 mm jack
- ✓ Power supply

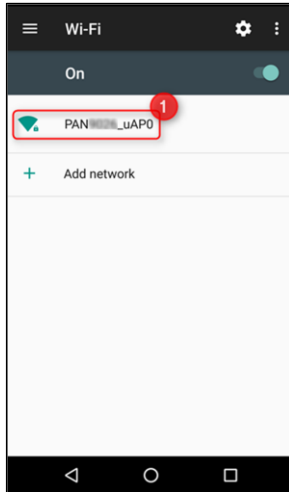
1. Insert the PAN9028-MSD into the μ SD card slot of the Baseboard (1).



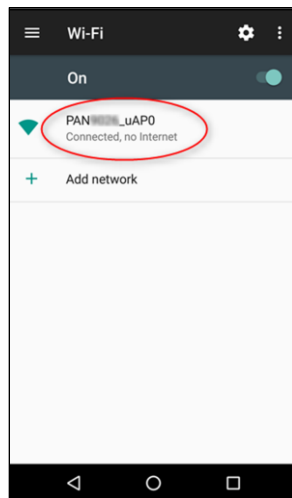
2. Insert the headphones with 3.5 mm jack into the green audio socket (2).
3. Insert the power supply (3).
 - ➔ The system will boot up. This takes approximately one minute.

4.2 Connecting to the Access Point

1. Navigate to the Wi-Fi configuration settings of the device and enable Wi-Fi.
2. Press **PAN9028_uAP0** (1) to connect to this access point which is provided by the PAN9028. It will be found automatically.



→ The connection will be established and is shown as **Connected, no Internet**.

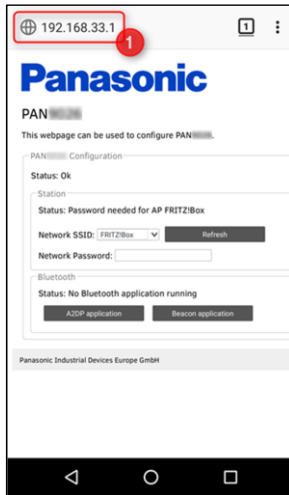


At this point it is possible to access the PAN9028, but not to use any features that required internet access.

4.3 Remote Controlling PAN9028-IMX

On the PAN9028-IMX a web server is running which provides the user interface for remote controlling the system.

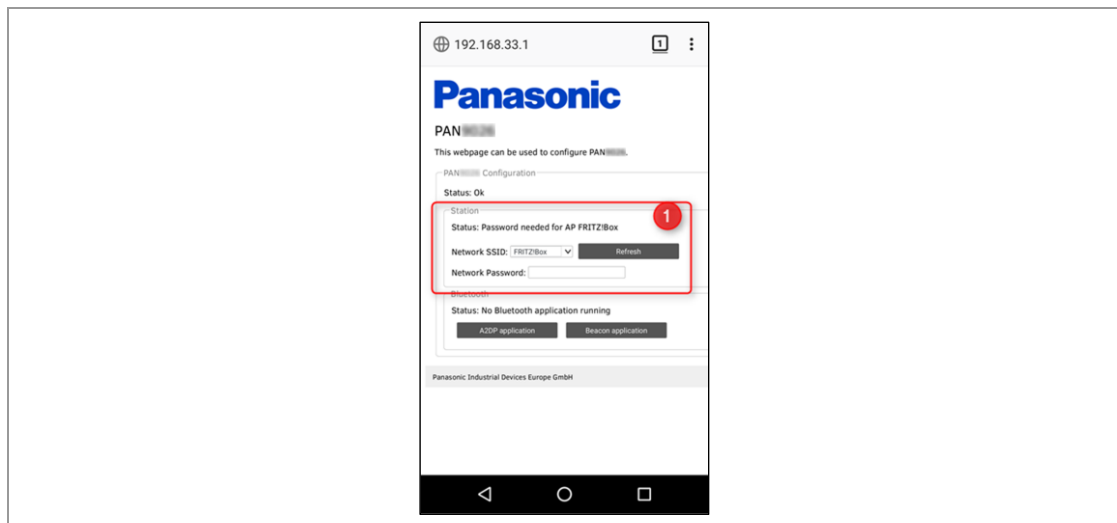
1. Open the **web browser**.
2. Navigate to the address **192.168.33.1** (1) to access.



4.4 Exploring Wi-Fi Features

4.4.1 Connecting to the Internet

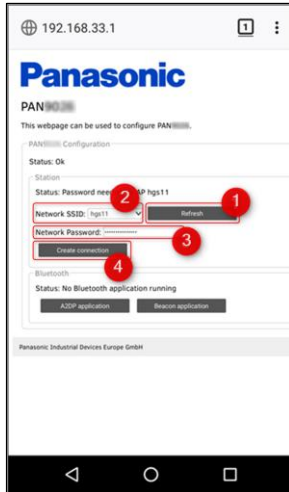
The Wi-Fi features of the PAN9028 can be controlled using the section **Station** (1) on the web page.



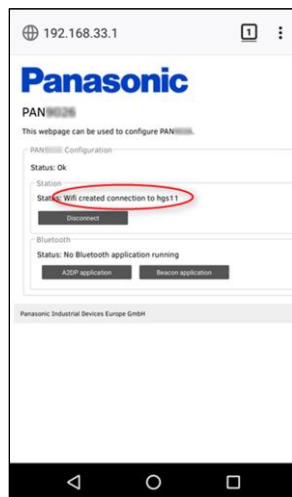
The PAN9028 is capable of connecting to an existing access point while acting as an access point itself.

The user interface is intuitive and will guide through the possible use cases.

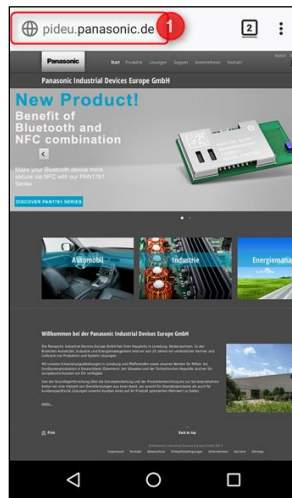
1. Press **Refresh** (1) to update the list of found access points.



2. Select the **Network SSID** (2) of the access point that should be used.
3. Enter the matching network password (3).
4. Press **Create Connection** (4) to create the connection.
 - ➔ The PAN9028 will connect to it. This takes approximately a couple of seconds.



- Now another browser window can be used to access any page in the internet, for example **pideu.panasonic.de** (1).



Because the PAN9028 is connected to an access point with internet connection, the device is now able to access the internet through the access point of PAN9028-IMX as well.

4.4.2 Measuring Wi-Fi Round Trip Time (RTT)

The Fine Time Measurement (FTM) capabilities of the PAN9028 can be used to make Round Trip Time (RTT) measurements. This is done by having a Wi-Fi station device initiate the measurement by sending a FTM request to an access point which acts as a responder. One way of testing those RTT measurements is, using the “WifiRttScan” application from Google® on an Android smartphone, which will be described in this section.

The following requirement must be met:

- ✓ The application “WifiRttScan” is installed on a smartphone that supports the Android “Wi-Fi RTT API”.



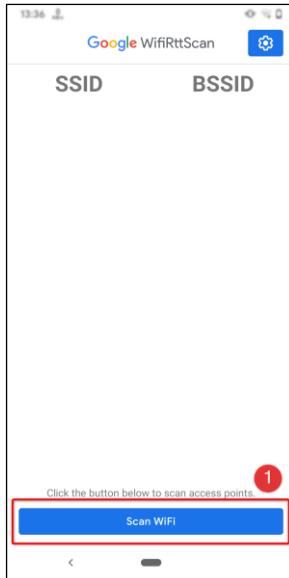
The application “WifiRttScan” can be downloaded from the Google Play Store with a capable smartphone.



To see a list of smartphones that currently support the Android “Wi-Fi RTT API” visit <https://developer.android.com/guide/topics/connectivity/wifi-rtt#supported-phones>.

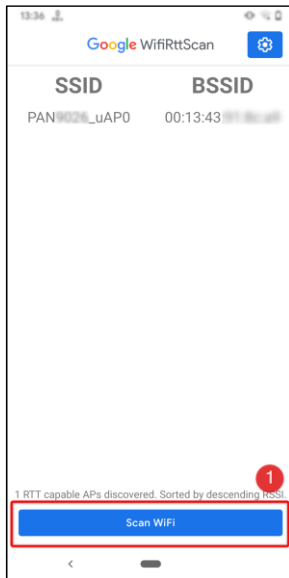
Measuring RTT

1. Enable Wi-Fi and location services on the smartphone (used for the RTT measurement).
2. Open the application **WifiRttScan**.
3. Press **Scan WiFi** (1).

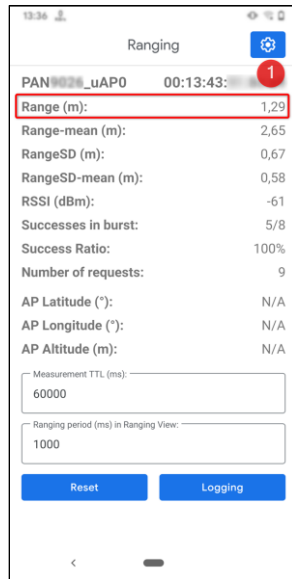


➔ The application will scan for all access points supporting FTM and list them.

4. Select the access point **PAN9028_uAP0** (1).

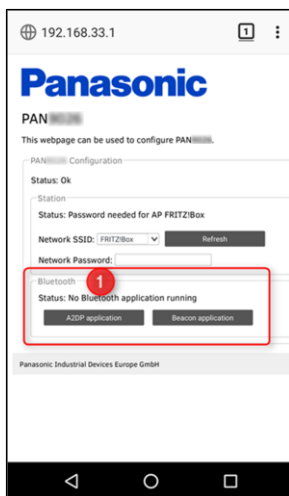


- The application displays the measured RTT range in meters (1).



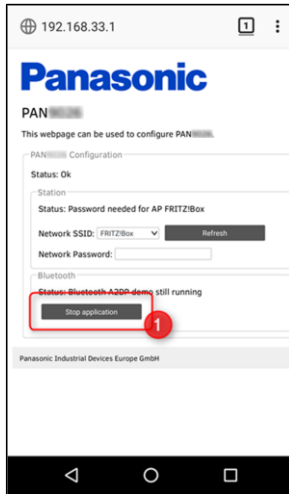
4.5 Exploring Bluetooth Features

1. Use the section **Bluetooth** (1) on the web page to control the Bluetooth features of the PAN9028.



Stopping Application

1. Press **Stop application** (1) to stop the currently running Bluetooth application.



4.5.1 Bluetooth Low Energy AltBeacon

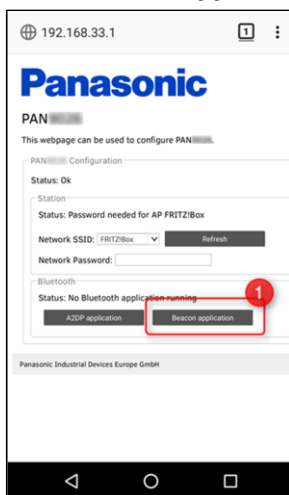


The application **Locate Beacon** from Radius Networks, Inc. can be used to discover the PAN9028.

It can be downloaded from the “Google Play Store” (for Android) and the “Apple® App Store” (for iOS).

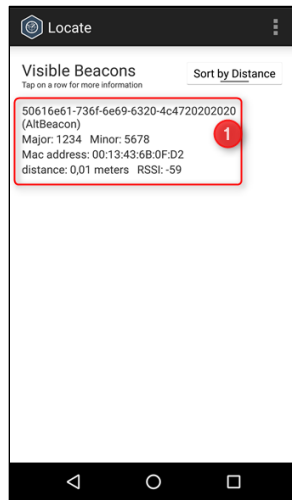
Starting AltBeacon

1. Press **Beacon application** (1) to start the application Bluetooth Low Energy AltBeacon.



➔ The device advertises according to the AltBeacon specification.

- ➔ In the application **Locate Beacon**, the PAN9028 will show up as a regular AltBeacon (1).

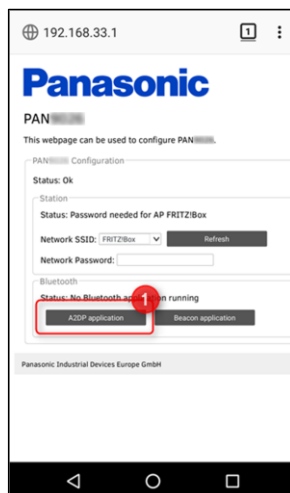


Please note that the distance measurement shown by the Locate Beacon application is calculated based on the received signal strength indicator (RSSI) and other implementation specific variables and therefore is not accurate.

4.5.2 Bluetooth Basic Rate A2DP Audio Sink

Starting A2DP

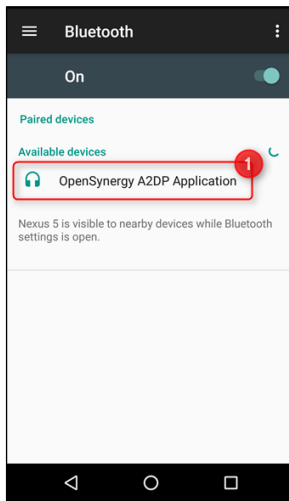
1. Press **A2DP application (1)** to start the Bluetooth Basic Rate A2DP audio sink application.



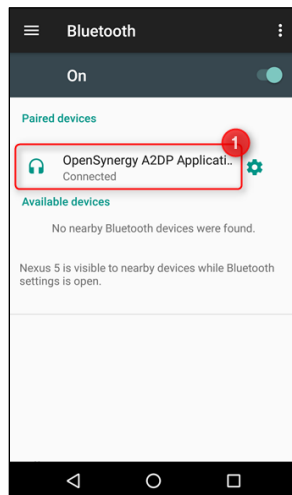
- ➔ The device will be available as an A2DP audio sink.
2. Navigate to the Bluetooth settings of the device and enable Bluetooth.

3. Press on the entry to connect to the PAN9028 (1).

Usually the PAN9028 will show up as `OpenSynergy A2DP Application`.



- The connection will be established and is shown as `Connected` (1). This takes approximately a couple of seconds.



- Now any audio that is played back on the Android device, will be routed to the PAN9028 instead and output on the audio jack of the PAN9028-IMX.



Depending on the connected headphones, the volume might need to be adjusted to a different level.

For instructions on how to control the volume please refer to
⇒ [5.3 Configuring Audio](#).



To verify the correct operation, start an application that will output sound, for example, an audio player, a video stream, a web radio, or video from the internet.

- ➔ The sound will be outputted, when some headphones are connected to the green audio jack of the Wandboard.



If the Android device is still connected to the access point of the PAN9028, make sure that the PAN9028 itself is connected to an access point with internet access; otherwise no playback from the internet is possible.

5 Full Usage

The main difference between the basic usage and the full usage is that the full usage additionally allows the user to control some of the features PAN9028, using the graphical user interface of the Ubuntu system.

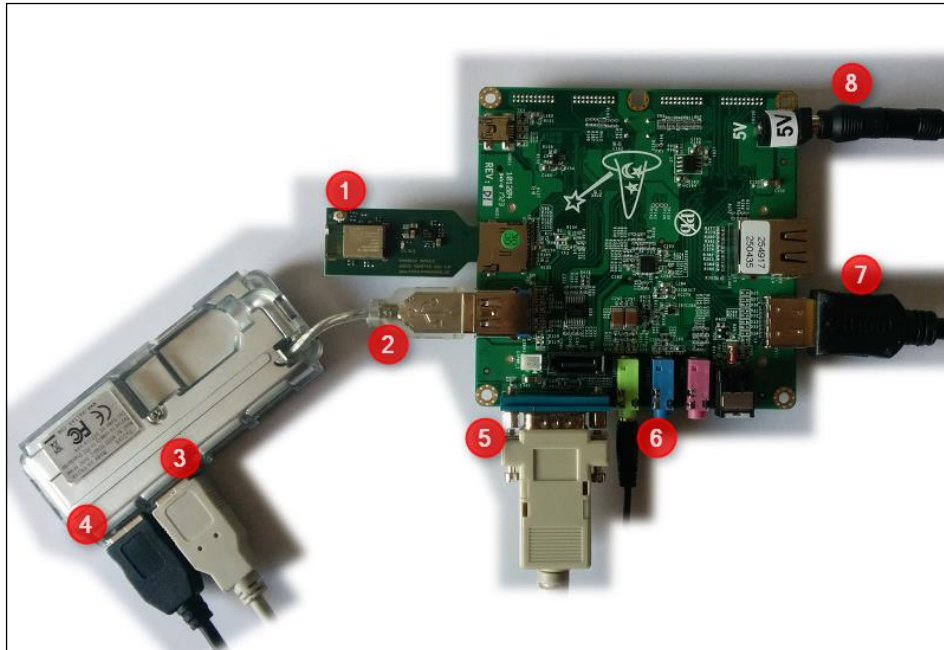
The same functionality as in the basic setup is available.

5.1 Setup (Full)

The following components are needed:

- ✓ Wandboard with μ SD card with Ubuntu Linux image
- ✓ PAN9028-MSD with μ SD card form factor
- ✓ USB hub
- ✓ USB keyboard
- ✓ USB mouse
- ✓ Serial port cable
- ✓ Headphones with 3.5 mm jack
- ✓ HDMI cable and matching monitor or TV set
- ✓ Power supply

1. Insert the PAN9028-MSD into the μ SD card slot of the Baseboard (1).



2. Insert the USB hub into the USB port of the Wandboard (2).
3. Insert the USB mouse into the USB hub (3).

4. Insert the USB keyboard into the USB hub (4).
5. Connect the serial port cable to the PC (5).
6. Insert headphones with a 3.5 mm jack into the green audio socket (6).
7. Insert the HDMI cable and connect it to an external HDMI monitor (7).
8. Insert the power supply (8).
 - ➔ The system will boot up. This takes approximately one minute. The boot process of the system is displayed on the attached monitor.



If no output can be seen on the attached monitor, please reselect the signal source to force the monitor to update the signal sources.

- ➔ When the boot process is finished, the Ubuntu desktop will be displayed
⇒ [5.2 Login](#).



5.2 Login

Once the operating system has finished booting, you will be automatically logged in as the user “ubuntu” (see ⇒ [5.1 Setup \(Full\)](#)). No manual login is required. The “ubuntu” user has root privileges.



The username of the default user is “ubuntu” and the password is always “ubuntu”.

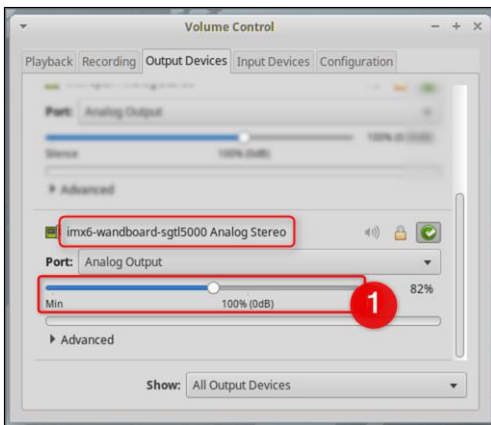
5.3 Configuring Audio

The audio configuration can be configured using the tool **PulseAudio Volume Control**.


1. In the main menu (1) select **Multimedia** (2) > **PulseAudio Volume Control** (3).

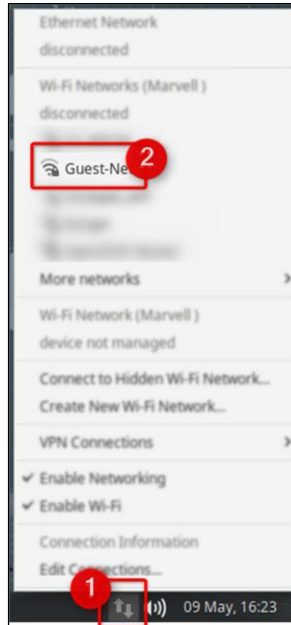


2. Control the volume in the section **imx6-wandboard-sgt15000 Analog Stereo** (1).

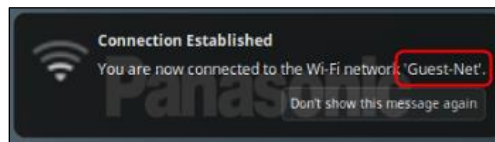


5.4 Configuring Wi-Fi

1. Navigate in the task bar to the Indicator section and click on the icon  (1) to open the Network Manager Applet.



2. Select an appropriate entry in the list of Wi-Fi networks to establish a connection (2).
 - ➔ The result of any network operation will be shown in a pop-up message in the upper right corner.



When the Wi-Fi settings are manipulated both through the web interface and the Network Manager applet, the state displayed on either side may be incorrect.

It may be necessary to reload the page on the web.

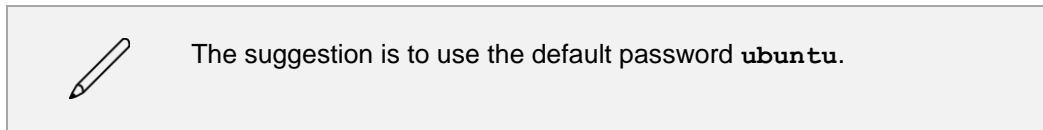
5.5 Accessing Network

The following requirement must be met:

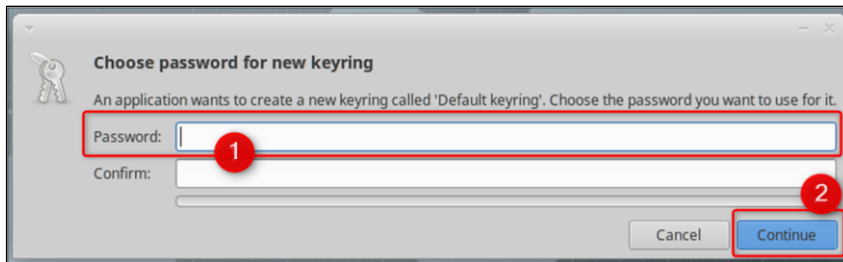
- ✓ Wi-Fi is configured ⇒ [5.4 Configuring Wi-Fi](#).

After a connection to a network has been established, any network application may be used.

1. Create a password for the keyring. The keyring is a place where all security related information for a user are stored.



2. Enter a password into the field **Password** (1).



3. Click **Continue** (2).
➔ Now any web page can be accessed.

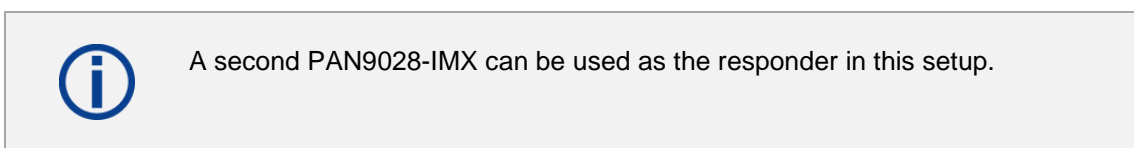
5.6 Using Wi-Fi Location Demo

Additionally to acting as a Fine Time Measurement (FTM) responder, the PAN9028-IMX can also be used as the initiator itself and make Round Trip Time (RTT) measurements. To demonstrate this feature, the system contains the “WiFi Location Demo”.

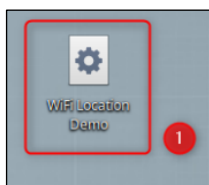
This section describes how to start and use the “WiFi Location Demo”.

The following requirement must be met:

- ✓ A Wi-Fi access point (supporting FTM) is available and running.



1. Open **WiFi Location Demo** (1), located on the desktop.
Alternatively, the “WiFi Location Demo” can be started from the command line: Type in `/home/ubuntu/nxp/wifi_location_app/wifi_location_demo.sh` and press **Enter**.



- ➔ A new terminal window will be opened.
- ➔ The application scans for Wi-Fi access points in reach and lists them (1).

```

Terminal
File Edit View Terminal Tabs Help
Scanning for AP's ...
Scan Result : 18 entry in Scan List
-----
# | Chan# | BSSID | SSID
-----
07 | 11 | 00:13:43: | PAN uAP0 1
...
Scan count 18
[q]. Terminate Application
[ctrl-d] RESCAN
Enter the AP index: 07 2
FTM [00:13:43: ]

Select option:
[0]. Terminate the application...
[1]. Start FTM Procedure
[2]. Neighbor Report Request
[3]. ANQP Request
Enter Selection :

```

2. Select the access point that should be used as the responder: Type in the according index (2) and press **Enter**.

- ➔ The application displays four options.

```

Select option:
[0]. Terminate the application...
[1]. Start FTM Procedure
[2]. Neighbor Report Request
[3]. ANQP Request
Enter Selection :

```

3. Type in 1 and press **Enter** to make a RTT measurement with the selected access point.

- ➔ The application will be displayed the result of a single RTT measurement.
- ➔ At this point an action can be chosen:

```

[1]. Restart FTM with same AP
[2]. Scan Again
[3]. Quit Application
Enter your choice: 1

```

4. Type in
 - 1 to restart the measurement,
 - 2 to scan for other access points,
 - 3 to quit the application.
5. Press **Enter** to confirm.

If 1 (“Restart FTM with same AP”) was chosen:

→ The application displays two more options:

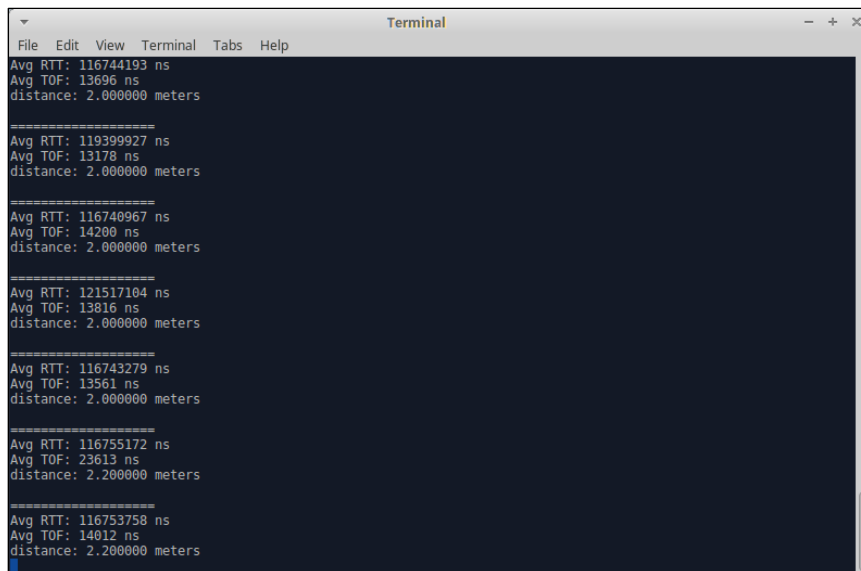
```
[1]. Restart FTM with same AP
[2]. Scan Again
[3]. Quit Application
Enter your choice: 1

[0]. run once
[1]. run in loop
Enter your choice: 1
```

6. Type in
 - 0 to take another single measurement,
 - 1 to let it run in a loop.
7. Press **Enter** to confirm.

If 1 (“run in loop”) was chosen:

→ The application displays the recorded data points indefinitely.



```
Terminal
File Edit View Terminal Tabs Help
Avg RTT: 116744193 ns
Avg TOF: 13696 ns
distance: 2.000000 meters
=====
Avg RTT: 119399927 ns
Avg TOF: 13178 ns
distance: 2.000000 meters
=====
Avg RTT: 116740967 ns
Avg TOF: 14200 ns
distance: 2.000000 meters
=====
Avg RTT: 121517104 ns
Avg TOF: 13816 ns
distance: 2.000000 meters
=====
Avg RTT: 116743279 ns
Avg TOF: 13561 ns
distance: 2.000000 meters
=====
Avg RTT: 116755172 ns
Avg TOF: 23613 ns
distance: 2.200000 meters
=====
Avg RTT: 116753759 ns
Avg TOF: 14012 ns
distance: 2.200000 meters
```

8. Type in **q** and press **Enter** to exit the application.



If the demo application fails to reestablish the original state of the networking setup after it has exiting:

1. Power cycling the PAN9028-IMX.
2. Reattaching the PAN9028-MSD.

5.7 Remote Access

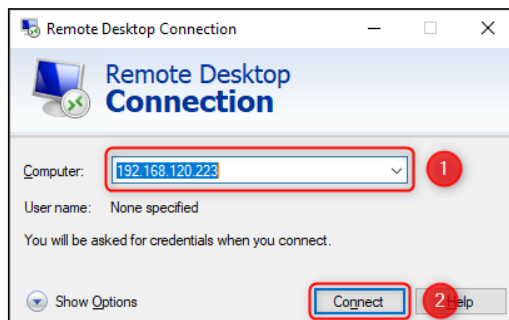
The Ubuntu system has the “xrdp” package installed. It allows for graphical remote access, using the Microsoft® Remote Desktop Protocol (RDP).

The following steps describe how the application **Remote Desktop Connection** can be used to establish a RDP connection to the PAN9028-IMX.

The following requirements must be met:

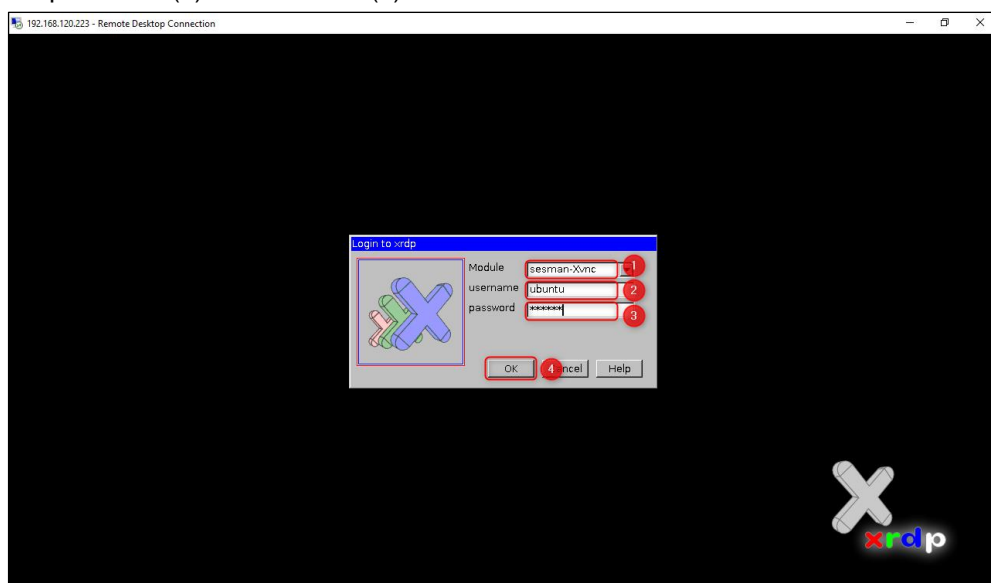
- ✓ The PAN9028-IMX is connected to a network over Ethernet. It has a known IP address assigned that is in the same address range as the host machine used for the remote access.
- ✓ The PAN9028-IMX is powered up and has finished booting.

1. Open the application **Remote Desktop Connection**.
2. Enter the IP address of the PAN9028-IMX (1) and click **Connect** (2).



- ➔ The application starts to establish a RDP connection to the PAN9028-IMX.
- ➔ A login window will be open.

3. Select **sesman-Xvnc** as Module (1), enter **ubuntu** as the username (2) and **ubuntu** as the password (3) and click **OK** (4).



- ➔ The Ubuntu desktop will be displayed and can be controlled remotely.

6 Recreating SD Card Image

During the evaluation of the system, it might be necessary to start from scratch.

To recreate the SD card image, the image needs to be written to the existing or a new SD card. How this can be achieved depends on the host system that is used.



Please contact your local Panasonic sales representative to obtain the SD card image.

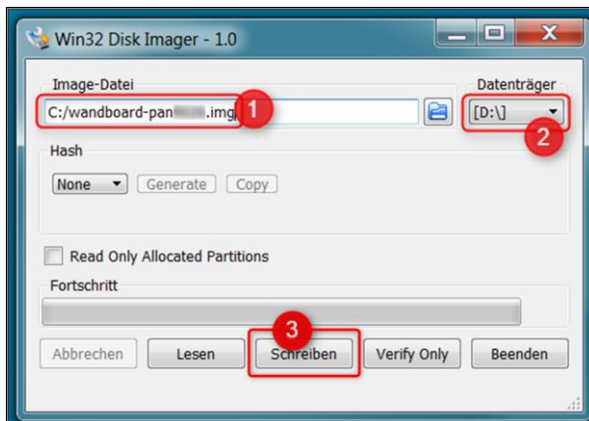
For using Windows please refer to ⇒ [6.1 Using Windows®](#).

For using Linux please refer to ⇒ [6.2 Using Linux](#).

6.1 Using Windows®

Using Windows, the **Win32 Disk Imager** or a similar tool, to write the SD card image to a SD card, can be used.

1. Select the image file (1).



2. Select a destination (2).
3. Click **Write (Schreiben)** (3) to write the SD card.

6.2 Using Linux

Using Linux, the easiest way is to use the tool **dd** on the command line.

1. Insert the target SD card into the device.
2. Open a terminal application window.

3. Use the command `lsblk` (1) to find out the device file name of the SD card.

```
xubuntu@xubuntu-vm:~/development/pan...$ lsblk
NAME        MAJ:MIN RM  SIZE RO TYPE MOUNTPOINT
sdb         8:16   1  14.6G  0 disk
├─sdb1      8:17   1   1.4G  0 part
└─sdb2     11:0   1  1024K  0 rom
sda         8:0     0   84G   0 disk
├─sda2     8:2     0    1K   0 part
├─sda5     8:5     0    8G   0 part [SWAP]
└─sda1     8:1     0   76G   0 part /
```

4. Check the column **SIZE** (2) to find the SD card.
5. Remember the name from the column **NAME** (3).
6. Enter the following code into the command `dd` to write the SD card image to the desired target drive: `sudo dd if=ubuntu-wandboard_vX_Y.img of=/dev/sdb bs=1M`



sudo is used because usually only the root user can write to device files like `/dev/sdb`.

7 Troubleshooting

7.1 Resizing Root Partition to Maximum Size

The original SD card image is about 1.5 GB in size. Even if it is written to a bigger SD card, the system will not use the remaining space automatically.

Execute the following steps as root user to resize the filesystem to occupy all the remaining space on the SD card.

1. Open a Terminal Window and become the root user:
`sudo su -`
2. Modify the existing partition table to occupy all the remaining space on the SD card:
`echo ", +" | sfdisk --no-reread -N 1 /dev/mmcblk2`
3. Make sure the Linux kernel gets to know the new partition size:
`partprobe /dev/mmcblk2`
4. Resize the existing filesystem on that partition:
`resize2fs /dev/mmcblk2p1`
5. Reboot the system for a clean start:
`reboot`

7.2 Fixing a Non-Booting System

The full setup contains a fully running Ubuntu system, which needs to be properly powered down before the system can be shut off.



Do not cut off the power supply before the PAN9028-IMX was properly shut down. It can lead to a filesystem corruption which might leave the system in an unbootable state.

If a corruption of the filesystem occurred because the power supply was cut off, the following message will be shown on the serial console while booting:

```
Welcome to emergency mode!
Press Enter for maintenance
(or press Control-D to continue).
```

1. Remount the root filesystem:
`mount -r -o remount /`
2. Execute a filesystem check on the partition, containing the root filesystem:
`fsck.ext4 /dev/mmcblk2p1`
3. Reboot the system:
`reboot`
→ Now the system starts up correctly again.

7.3 Updating System

The system is a regular Ubuntu Linux system. Therefore the system-level tools like “apt-get” are available to update the system or install additional packages.

8 Life Support Policy

This Panasonic Industrial Devices Europe GmbH product is not designed for use in life support appliances, devices, or systems where malfunction can reasonably be expected to result in a significant personal injury to the user, or as a critical component in any life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

Panasonic customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Panasonic Industrial Devices Europe GmbH for any damages resulting.

9 Contact Details

9.1 Contact Us

Please contact your local Panasonic Sales office for details on additional product options and services:

For Panasonic Sales assistance in the **EU**, visit

<https://eu.industrial.panasonic.com/about-us/contact-us>

Email: wireless@eu.panasonic.com

For Panasonic Sales assistance in **North America**, visit the Panasonic website “Sales & Support” to find assistance near you at

<https://na.industrial.panasonic.com/distributors>

Please visit the **Panasonic Wireless Technical Forum** to submit a question at

<https://forum.na.industrial.panasonic.com>

9.2 Product Information

Please refer to the Panasonic Wireless Connectivity website for further information on our products and related documents:

For complete Panasonic product details in the **EU**, visit

<http://pideu.panasonic.de/products/wireless-modules.html>

For complete Panasonic product details in **North America**, visit

<http://www.panasonic.com/rfmodules>